

# Prey Preferences of Carnivorous Intertidal Snails in the Florida Keys

BY

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## INTRODUCTION

SIX SPECIES OF CARNIVOROUS GASTROPODS are commonly found in the midtidal region (yellow zone, STEPHENSON & STEPHENSON, 1950) of the intertidal rocky platform in the Florida Keys. These snails occur primarily from the southeastern United States through the Caribbean. Their feeding habits are poorly known.

The prey preferences of these snails were studied as a first step toward a better understanding of the intertidal trophic relationships in this area and the effects of the predators on the distribution, zonation and diversity of their prey.

The relationships between preference and availability of food and the feeding methods and activity patterns were examined for the following species of carnivorous snails: *Thais haemastoma floridana* (Conrad, 1837), *Th. deltoidea* (Lamarck, 1822), *Th. rustica* (Lamarck, 1822), *Morula nodulosa* (Adams, 1845), *Pisania tinctoria* (Conrad, 1846) and *Leucozonia nassa* (Gmelin, 1791).

## STUDY AREAS AND METHODS

Observations were made on sections of limestone beach-rock parallel to the shore at sites located on Pigeon Key (24°42'N; 81°09'W) and on the south shore of Key Vaca (24°43'N; 81°05'W). The sections, centered at the midtidal level, varied in width from approximately 1.0 m to 1.5 m, depending upon the slope of the platform.

Feeding activity was observed at low tide when the platform surface was exposed. Snails were considered to be actively feeding if they proved difficult to remove when gently rolled onto their sides and if the proboscis was seen retracting from the prey. Removing the predator prevented duplicating the same observation and allowed the predator to select another prey before the next observation period. For each feeding observation the following were recorded: species and size of predator and prey;

percent of snails feeding, and method of entry by snail. At each site the same strip of platform was examined during each observation period which lasted about 90 minutes and included over 100 observations of feeding. Population sizes of predators and prey were obtained from random square meter samples taken within the "yellow" zone.

## RESULTS

### Food Preferences

The relationships between preference for and abundance of food for the 5 species of carnivorous snails at Pigeon Key are shown in Table 1. The vermetid snail, *Spiroglyphus annulatus* (Daudin, 1800), was the most common prey (relative abundance 99.2%) and made up 83.9% (*Pisania tinctoria*) to 99.8% (*Morula nodulosa*) of the diets of the predators. The other species of prey: the tree oysters *Isognomon bicolor* (Adams, 1845) and *I. radiatus* (Anton, 1839), the mussel *Brachidontes exustus* (Linnaeus, 1758) and the barnacle *Tetraclita squamosa* (Lamarck, 1818) constituted no more than 8.1% of the diet of any predator. *Thais deltoidea* and *Th. rustica* had the most varied diets, feeding on all 4 of the common species of prey. Occasional prey of the Pigeon Key carnivores were the gastropod *Astraea tecta americana* (Gmelin, 1791), *Batillaria minima* (Gmelin, 1791), *Cerithium eburneum* (Bruguière, 1792) and *Columbella mercatoria* (Linnaeus, 1758). Cannibalism by *Thais deltoidea* was also observed.

On Key Vaca the 3 species of *Thais*, *Th. deltoidea*, *Th. haemastoma floridana* and *Th. rustica*, were the only predators found (Table 2). The commonest prey of the 3 predators combined was *Tetraclita* (46%), followed by *Isognomon* (37.2%) and *Brachidontes* (14.7%). *Spiroglyphus*, the most common prey on Pigeon Key, was not found on Key Vaca. Among the 3 thaides, *Th. rustica* preferred barnacles (60% of its diet) and *Th. haemastoma*

Table 1

Relationship of frequency of prey in the diets of carnivorous intertidal snails to the abundance of prey species at Pigeon Key, Florida

Prey	Relative abundance (%)	Frequency in diet — % of total prey					Sum of all predators
		<i>Thais deltoidea</i>	<i>Thais rustica</i>	<i>Morula nodulosa</i>	<i>Leucozonia nassa</i>	<i>Pisania tinctoria</i>	
<i>Spirogyllus annulatus</i>	99.2	92.2	92.2	99.8	97.9	83.9	95.7
<i>Isognomon bicolor</i> and <i>I. radiatus</i>	0.5	5.5	6.0	0.2	0.7	8.1	2.8
<i>Tetrachita squamosa</i>	0.2	0.5	0.6	0	0	0	0.2
<i>Brachidontes exustus</i>	0.1	0.2	0.6	0	0	0	0.16
Other	—	1.6	0.6	0	1.4	8.0	1.14
% observed feeding		49.0	69.6	52.9	51.4	23.6	50.2
Total observations		784	240	946	554	263	2787
Total observed predations		384	167	500	285	62	1398

ate large numbers of mussels (30.8% of its diet). Only *Th. deltoidea* fed on species (*Batillaria minima* and *Th. rustica*) other than the 3 major prey.

#### Feeding Methods and Activity Patterns

Although all of the predators studied, except *Leucozonia nassa*, are functional drills, active drilling was confirmed in only 8 of the 1704 predations observed. Entry into the most common prey, *Spirogyllus*, was obtained by inserting the proboscis into the tubular shell and forcing the operculum aside.

High wave action caused a pronounced reduction in feeding activity. In one case there was a 100% increase in the number of feedings observed immediately after 2 days of high winds.

Feeding activity of all of the predators was higher at night. The percentages of snails of the different species feeding at midday versus midnight at Pigeon Key were as follows: *Thais deltoidea* 37% and 65%; *Th. rustica* 38% and 48%; *Leucozonia nassa* 46.6% and 64.6% and *Morula nodulosa* 50.7% and 62.4%. *Pisania tinctoria* is almost completely nocturnal; only 5 of 263 (1.9%) individuals observed at Pigeon Key were feeding during daylight hours.

Specimens of *Thais* (7 *Th. rustica*, 6 *Th. haemastoma*, and 5 *Th. deltoidea*) were transplanted from Key Vaca, where no *Spirogyllus* occurred, to Pigeon Key to determine their reaction to unfamiliar prey. During a 7 day observation period following transplantation 15 feeding snails were observed, all on *Spirogyllus*.

Table 2

Relationship of frequency of prey in the diets of carnivorous intertidal snails to the abundance of prey species at Key Vaca, Florida

Prey	Relative abundance (%)	Frequency in diet — % of total prey			Sum of all predators
		<i>Thais deltoidea</i>	<i>Thais haemastoma</i>	<i>Thais rustica</i>	
<i>Isognomon bicolor</i> and <i>I. radiatus</i>	27.6	41.9	44.2	34.0	37.2
<i>Tetrachita squamosa</i>	71.1	35.5	25.0	60.0	46.0
<i>Brachidontes exustus</i>	1.3	16.1	30.8	6.0	14.7
Other	—	6.5	0	0	2.1
% observed feeding		28.8	38.3	45.6	40.2
Total observations		149	227	386	762
Total predations		43	87	176	306

## CONCLUSIONS

*Thais haemastoma* has been reported to feed primarily on mussels, oysters, clams and barnacles (BUTLER, 1953, RADWIN, 1968) but there is no published quantitative information on the food preferences of *Th. deltoidea* or *Th. rustica*. Our observations show that the common thאים in the Florida Keys feed primarily on sessile vermetid snails, when they are available, but that in the absence of vermetids they feed on barnacles, oysters and mussels in direct relation to the relative abundance of the prey species.

Pacific coast relatives of *Morula nodulosa* and *Pisania tincta* are reported to feed almost exclusively on barnacles (PAINE, 1966a). In the Keys these 2 species occur low in the intertidal zone and thus their preference for *Spiroglyphus* as prey may be because they do not normally move up to the levels where barnacles or bivalves are common.

*Leucozonia nassa* (family Fascioliidae) is not a drill but enters its prey by inserting the proboscis together with mild rasping of the radula and use of the shell margin. PAINE (1966b) reports that many small fasciolarids feed on tubicolous worms and WILLCOX (1895) observed *Fasciolaria hunteria* (G. Perry, 1811) eating the vermetid snail *Petalococonchus nigricans* (Dall, 1884). The feeding mechanism of *L. nassa* probably restricts its diet in the Keys primarily to vermetid snails and tubicolous polychaetes.

Preference of all of the predators for *Spiroglyphus* as food is most easily explained by the abundance and ease of entry to the prey. However, because of its small size (under 10 mm long by 2 mm wide) the consumption rate for this prey must be very high. Predators on this species, accordingly, would be expected to spend a greater amount

of their time feeding. Indeed, the percent of *Thais deltoidea* and *Th. rustica* observed feeding on Pigeon Key was much higher than on Key Vaca, 49.0% versus 28.8% and 69.9% versus 45.6% respectively. Further, all of the predators on Pigeon Key, except *Pisania tincta*, fed both day and night.

Boring activity by the predators was rarely observed although most possess a drilling mechanism. There is probably little or no drilling involved in entering barnacles and vermetid snails which made up a large portion of the prey. CONNELL (1961) has observed that the thאים in California are barnacle specialists and seldom drill.

Only the 3 species of *Thais* were found where *Spiroglyphus* was absent. However, the exact relationships between predator and prey distribution, abundance and diversity in the Keys will require further study.

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